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NATIONAL REFERENCE
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 AND INVENTION

(54) TEXTILE FLOOR COVERING

- (71) We, BAYER AKTIENGESSELL-
 SCHAFT, formerly known as Farbenfabriken
 Bayer Aktiengesellschaft, a body corporate
 organised under the laws of Germany of 509
 Leverkusen, Germany, do hereby declare the
 invention, for which we pray that a patent
 may be granted to us, and the method by
 which it is to be performed, to be particularly
 described in and by the following statement: —
 10 This invention relates to a textile floor
 covering with a plastics underlay which has a
 permanently elastic, optionally adhesive back-
 ing based on cold-crosslinking polyurethane
 elastomers.
 15 Tiles, usually cut out into geometric shapes
 which can be laid without any difficulty, are
 being used to ever-increasing extent as textile
 floor covering, especially in private dwellings.
 Whereas in the past tiles were made from the
 residues accumulating during production, it is
 becoming increasingly more commonplace to
 develop articles adapted to the special require-
 ments which should be satisfied by carpet tiles.
 25 One of the requirements which must be satis-
 fied by products of this kind is that they should
 remain dimensionally stable under variations
 in such conditions as temperature and moisture.
 In addition, tiles which are to be laid in the
 absence of an adhesive are required to rest
 30 firmly on any support under their own weight
 and flexibility. One particularly important fac-
 tor is the elimination of any tendency on the
 part of the tiles to dislocate through warping.
 Floor tiles having a heavy backing of filled
 35 polyvinyl chloride, natural or synthetic latices,
 or bitumen are known, as are tiles coated with
 an olefinic composition to enable them to re-
 main firmly in position not only under their
 own weight, but also under the effect of limited
 40 adhesion to the floor.

[Price 25p]

All the aforementioned coatings are either
 hard, brittle, or plastic so that they do not in
 any way increase the tread elasticity required.
 These coatings can only be applied by means
 of cumbersome coating apparatus which occu-
 pies a considerable amount of space and con-
 45 sumes large amounts of energy. Some types
 of fibre (for example polyvinyl chloride fibres,
 polyacrylonitrile fibres and polypropylene
 fibres) cannot be coated in this way because
 50 of the high temperature required.

The present invention relates to a floor
 covering which comprises a textile surface layer
 and bonded thereto a non-foamed polyurethane
 elastomer underlay formed from a polyhydroxy
 55 compound and a polyisocyanate used in an
 OH/NCO molar ratio of from 1:0.6 to 1:1.3.

The surface layer can, for instance, comprise
 two or more superposed layers, needled
 together without additional consolidation.
 60

Textile floor coverings of this kind may be
 produced by a process which comprises mixing
 the polyhydroxy compound and the polyiso-
 cyanate, coating the textile surface layer at
 room temperature with the resulting liquid
 65 mixture which does not foam and storing the
 product in the absence of tension at least until
 the polyurethane has solidified.

In an alternative process, a supporting web
 may be coated with the liquid mixture at room
 temperature which does not foam, the textile
 surface layer is applied to the coated web, and
 the product is stored in the absence of tension
 at least until the polyurethane is solidified.
 70

The polyurethane underlay may be univers-
 ally used for all types of textile floor covering,
 comprising any natural and/or synthetic fibres,
 and for any application, for example, in private
 dwellings, in indoor sports areas and in sports
 80 stadia. The coating composition is inexpensive

and easy to process and, in its fully reacted form, is flexible, permanently elastic and dimensionally stable over wide temperature ranges. In addition, the composition of the polyurethane can be adjusted in such a way that, when it is fully reacted, a permanently tacky elastic layer is formed which exhibits adhesive properties. The composition is a polyurethane elastomer which hardens at room temperature and to which fillers can be added in order to obtain a higher specific gravity.

The coating composition may be applied in liquid form through metering pumps and a mixing head either directly to the textile floor covering itself or to a supporting web, in which case the textile floor covering is subsequently applied to the resulting coated supporting web. The reaction, which takes place in the absence of externally-supplied energy, allows the use of extremely simple machine units, for example endless conveyor belts, which guarantee a complete reaction in the absence of tension.

Another form of apparatus which may be used comprises two synchronously driven rollers arranged with a gap between them, either one above the other or adjacent one another.

One roller is protected against any accumulation of reaction mixture by the substrate which is being coated, whilst the other roller is protected by a co-rotating covering of a suitable material having a separating effect with respect to the fully reacted reaction mixture. The layer thickness of the polyurethane is automatically determined by the width of the gap between the two rollers. Naturally, any differences in the thickness of the substrate are compensated in this method of coating.

After the polyurethane has reacted, the co-rotating coverings can be detached and re-used. Suitable coverings include, for example, films of polyolefins and barrier papers which have been coated with silicones or otherwise made repellent. It is also possible to use fabrics impregnated with polytetrafluoroethylene or silicone rubber, optionally in the form of endless covering strips. One requirement which must be satisfied by these covering materials is that they should show sufficient surface stability at temperatures of up to about 50° C., and should not adhere permanently to the polyurethane used.

Naturally, it is also possible by virtue of this process to carry out so-called reversal coating, i.e. the substrate is applied to the surface of the reaction mixture lying on top of the covering. The advantage of this lies in the lower penetration of the coating material into the substrate. This is particularly desirable with open or thin substrates.

Naturally, it is possible for the polyurethane to penetrate deeply into the substrate, especially when special consolidation effects are required. In this instance, it is of advantage to apply the reaction mixture to the substrate and

to apply the covering material as the uppermost layer. It is extremely easy to incorporate special net-like reinforcing materials by passing these materials together with the polyurethane used or with the substrate through the apparatus described above. Naturally, this is only possible with materials which, by virtue of their open structure, allow the reaction mixture to flow through with little or no resistance.

The reaction time can be varied within wide limits, depending upon the particular requirements. The hardness of the coating can be adapted to meet particular requirements by varying the ratio of the individual components within the range set out herein. It is possible, by virtue of the process according to the invention, to coat such textile products as, for example, needled felts, tuftings, pile fabrics, knitted fabrics and Raschel webbing, depending upon particular requirements, to form textile floor coverings. The backing used according to the invention also enables floor tiles to be produced from tufted carpeting without any need for previous knop solidification because the coating shows outstanding adhesion even to synthetic fibres.

In the production of needled felts for floor coverings, a special heavy-duty layer, which also gives the finished floor covering, its required appearance, is usually needled on to an underweb. This underweb usually contains one or more supporting fabrics to enhance its dimensional stability. The underweb (or cushion layer) is intended to impart to the floor covering the tread elasticity required for textile coverings, and to improve dimensional stability. Needled felt products of the kind used in conventional floor coverings have to be additionally hardened, usually by means of dispersed or dissolved plastics, in order to obtain high performance properties. This involves a considerable outlay in terms of apparatus, energy and time for the operations required. When the polyurethane coating according to the invention is used, the heavy duty layer is needled onto a supporting fabric and coated without previous chemical consolidation. By virtue of the special properties of the polyurethanes used according to the invention, it is of course possible to consolidate the reverse side when the backing is applied. In this process, the constitution of the reaction mixture is adjusted in such a way that from one quarter to three-quarters of the reaction mixture penetrates into the needled tread layer to be consolidated. The depth of penetration is governed by the texture of the needled felt (type and density of the fabric), and by the composition of the coating used. The needled felt floor covering thus obtained has a soft binder-free textile tread layer.

In contrast to conventional needled felts, consolidated by the so-called padding process, in which the individual fibres are merely bonded, where they touch one another, by the plastics dispersions used, the needled fibres are

intimately bonded by being embedded in a polyurethane matrix in the process according to the invention. The articles thus obtained are highly resistant to wear and tear, and show outstanding tread elasticity. This process eliminates the need for extensive consolidation operations with aqueous plastics dispersions and the subsequent drying of up to 2 kg of water per sq. metre. When a needled felt floor covering manufactured by the process described above is to be marketed in the form of tiles which can be laid in the absence of a separate adhesive, the coating composition is best applied in the form of a relatively thick layer in order to increase the weight of the tiles.

Examples of suitable polyhydroxyl compounds for producing the polyurethane elastomers include polyethers of ethylene glycol, propylene glycol and/or butylene glycol having two or more terminal OH groups and an average molecular weight of from 300 to 5000, or mixtures thereof, reacted with polyisocyanates. Particularly good results have been obtained with tolylene-2,4- and -2,6-diisocyanate and mixtures thereof in any ratio, the crude phosgenation product of the condensation product of aniline and formaldehyde, diphenylmethane-4,4'-diisocyanate and diphenylmethane diisocyanate modified with from 5 to 10% by weight of carbodiimide. In order to adapt the reaction between the polyhydroxyl compounds and the polyisocyanates to the manufacturing conditions, it is best to accelerate it through the addition of activators, for example dibutyl tin dilaurate, tin dioctoate or tertiary amines. Barium sulphate or kaolin may be used as fillers. The OH:NCO ratio between the reacting components is in the range from 1:0.6 to 1:1.3. It should be from 1:1 to 1:1.3 (OH:NCO) for dry, non-tacky coatings. When a self-adhesive surface is required, a ratio of from 1:0.6 to 1:1 should be used. In order to eliminate the influence of moisture, which results in bubble formation, mineral drying agents may be added.

The following Examples illustrate the invention:—

Example 1.

A web obtained by the conventional process using cards and leasers, consisting of:

35% by weight of poly(ethylene glycol terephthalate) fibres, dtex 17, 80 mm staple length,

15% by weight of poly(ethylene glycol terephthalate) fibres, dtex 17, 100 mm staple length, and

50% by weight of polyamide-6 fibres, dtex 135, 60 mm staple length,

is pre-needled on a needle loom to a penetration depth of 15 mm, turned, and then needled to a depth of 15 mm on to a polyester supporting fabric weighing 110 g per square metre. This is followed by finish-needling to

a depth of 16 mm. Total number of stitches per square centimetre: 217.

In order to produce a heavy floor covering tile, 3.5 kg of a non-tacky coating comprising component A and component B in a ratio by weight of 100 parts by weight of component A to 10 parts by weight of component B are applied to one side of this stitched felt.

Component A comprises:

60% by weight of a branched polyether of propylene oxide and trimethylol propane with an OH number of 36,

37% by weight of a linear polypropylene oxide with an OH number of 28,

2.9% by weight of sodium aluminium silicate, and

0.1% by weight of dibutyl tin dilaurate.

Component B comprises:

crude diphenylmethane - 4,4' - diisocyanate having an NCO content of 31% by weight.

The two components are mixed in a mixing head and then applied to the needled felt. The molar ratio of OH to NCO is 1:1.29. The liquid coating mixture is uniformly distributed over the horizontally disposed felt web and up to 50% penetrates into the felt structure. After a reaction time of approximately 5 minutes, the coating is tack free and, if desired, can be cut into tiles. Since this coating continues to react for a short time, the cut tiles are stored for 8 hours while lying flat. The polyurethane layer thickness is 3 mm.

Example 2.

A web produced by the conventional process using cards and leasers, consisting of:

50% by weight of polyacrylonitrile fibres, dtex 17, 100 mm staple length,

35% by weight of polyamide-6 fibres, dtex 135, 60 mm staple length,

15% by weight of polyamide-6 fibres, dtex 90, 90 mm staple length,

is needled to a depth of 15 mm on a needle loom, turned and then needled to a depth of 14 mm on to a polyester supporting fabric weighing 110 g per square metre. This is followed by finish needling to a depth of 12 mm. Total number of stitches per square cm: 234.

A uniformly thick floor covering is applied to the one side of this felt web by means of a coating machine. The coating machine consists of two synchronously driven rollers arranged with a gap between them either above one another or adjacent one another, through which the felt web to be coated and a polyethylene film are guided. The coating machine is laterally defined by polyethylene wedges adapted to the diameter of the rollers.

Alternatively, the material can also be applied by direct coating.

The coating composition either delivered

continuously from a casting machine to the polyethylene film or coated directly on to the web comprises:

- 5 100 parts by weight of a mixture of 60%
by weight of a branched polyether of propylene oxide and trimethylol propane with an OH number of 36,
37% by weight of linear polypropylene oxide with an OH number of 28,
10 2.9% by weight of sodium aluminium silicate, and
0.1% by weight of dibutyl tin dilaurate to which 10 parts by weight of diphenylmethane - 4,4' - diisocyanate has been added,
15 (molar ratio OH : NCO = 1 : 1.29). The coating is transferred to the web from the polyethylene film and distributed by the upper roller up to the lateral wedges or the coating as applied directly to the web. The plastics-coated floor covering thus obtained shows an absolutely uniform thickness of the kind required for a floor covering. The polyurethane layer thickness is 2.5 mm.

Example 3.

A web produced by the conventional process using cards and leasers, consisting of:

- 30 25% by weight of poly(ethylene glycol terephthalate) fibres, dtex 17, 80 mm staple length,
25% by weight of polyacrylonitrile fibres, dtex 17, 100 mm staple length,
15% of polyamide-6 fibres, dtex 135, 600 mm staple length,
35 is pre-needled to a depth of 15 mm on a needle loom, turned and then needled to a depth of

15 mm on to a polyester supporting fabric weighing 110 g per square metre. This is followed by finish needling to a depth of 12 mm. Total number of stitches per square cm: 217.

The coating composition delivered continuously from a casting machine, consisting of 100 parts by weight of a mixture of:

- 45 60% by weight of a branched polyether of propylene oxide and trimethylol propane with an OH number of 26,
37% by weight of linear polypropylene oxide with an OH number of 28,
2.9 by weight of sodium aluminium silicate, and
50 0.1% by weight of dibutyl tin dilaurate, to which 6 parts by weight of diphenylmethane-4,4'-diisocyanate have been added, is cast on to the side of the needled felt web which is to be coated by means of the coating machine described in Example 2. The OH : NCO molar ratio is 1 : 0.78. The backing obtained on completion of the reaction is permanently tacky and elastic. For laying the protective covering is merely peeled off and the tiles laid on a dust-free floor. The polyurethane layer thickness is 3 mm.

The abrasion resistance and dimensional stability of the products of Examples 1, 2 and 3 were measured by methods described by the Study Group on needled felt floor coverings of the German Carpet Research Institute, Aachen. Details of these methods are set out in a paper in "Normenausschluss" (RAL—AG/t, January 1969, Ziffer 2T). The results obtained are set out in the following tables:

TABLE 1

(Abrasion Resistance)

Example		1	2	3	>
Amount abraded (g/m ²)	without polyurethane underlay	172.9	263.4	146.6	
	with polyurethane underlay	71.4	95.1	84.8	

TABLE 2

(Dimensional Stability)

Example	1		2		3	
	With	Without	With	Without	With	Without
Polyurethane						
2 hr. at 60°C	-0.2%	-0.4%	-0.2%	-0.8%	-0.1%	-0.4%
2 hr. in water	0%	+0.1%	+0.1%	-0.5%	-0.1%	-0.3%
24 hr. at 60°C	-0.3%	-0.8%	-0.4%	-2%	-0.2%	-0.8%
48 hr. NK*	-0.1%	-0.5%	-0.2%	-1.3%	-0.1%	-0.4%
Mark	5	4	5	<4	5	4

* NK = 65% Atmospheric humidity at 22°C.

The mark 5 means that the product has a dimensional stability high enough for freely-laid carpet tiles, whilst mark <4 means that the product is unsuitable for use as a floor covering.

Example 4.

A dense-pile textile web produced on a Raschel knitting machine in which two guide bars work the backing [fringe and weft of Nm 17/1 cotton (continental)] into which 400 g per sq. metre of webbing produced separately from polyacrylonitrile fibres are worked, is used as heavy-duty layer for a textile floor covering which can be used in the form of tailored pieces, preferably for carpeting bathrooms and toilets. For this purpose, a frame in the subsequent shape of the floor covering section is placed on the back on the heavy-duty layer. The 5 mm tall frame consists of polyethylene to prevent the coating composition from adhering. The polyurethane composition is poured into this frame up to its edges and left to react for 5 minutes. The polyurethane mass is mixed homogeneously with a stirrer and consists of 100 parts by weight of a mixture of 60% by weight of a branched polyether of propylene oxide and trimethylol propane with an OH number of 36,

- 30 37% by weight of linear polypropylene oxide with an OH number of 28,
- 2.9% by weight of sodium aluminium silicate, and
- 35 0.1% by weight of tributyl tin dilurate to which 10 parts by weight of diphenylmethane-4,4'-diisocyanate are added (OH:NCO ratio 1:1.29).

- 40 After the frame has been removed, the floor covering section is cut out and stored for 8 hours on a flat surface to prevent the material from buckling during the reaction of the polyurethane coating. The polyurethane layer thickness is 2.5 mm.

Example 5.

A warp pile fabric produced on a warp knitting machine is used as heavy-duty layer for a highly wear-resistant floor covering. The polyamide-6 knitted pile webbing worked with two guide bars consists of polyamide-6 dtex 44 with 9 filaments in the first guide bar and polyamide-6 dtex 100, again with 9 filaments in the second guide bar. The polyurethane coating composition according to Example 2 is applied in the back of this warp pile fabric and at the same time a glass cloth is worked in. The polyurethane layer thickness is 3.5 mm.

The polyurethane coating composition used consists of 100 parts by weight of a mixture of

- 60 60% by weight of a branched polyether of propylene oxide and trimethylol propane with an OH number of 36,
- 37% by weight of linear polypropylene oxide with an OH number of 28,
- 65 2.9% by weight of sodium aluminium silicate and
- 0.1% by weight of dibutyl tin dilurate to which 10 parts by weight of diphenylmethane-4,4'-diisocyanate have been added (OH:NCO ratio 1:1.29). After a reaction time of 5 minutes, the coating can be cut. The floor covering is laid out flat to allow it to react fully.

Example 6.

A pile fabric produced on a tufting machine is coated with polyurethane elastomer after the usual finishing operations, and in the absence of knop consolidation. Floor covering tiles which can be laid in the absence of an adhesive are obtained for an application of 2 kg per square metre to the back of the tufted heavy-duty layer. The high adhesion of the coating composition to the fibrous material used eliminates the need for an additional knop consolidation. The coating composition is applied

by the machine described in Example 2. The polyurethane coating composition used consists of 100 parts by weight of a mixture of 60% by weight of a branched polyether of propylene oxide and trimethylol propane with an OH number of 36, 37% by weight of linear polypropylene oxide with an OH number of 28, 2.9% by weight of sodium aluminium silicate and 0.1% by weight of dibutyltin dilaurate to which 10 parts by weight of diphenylmethane-4,4'-diisocyanate have been added (OH:NCO ratio 1:1.29). The pile knops in the base fabric were found to have a bond strength of 13 kp.

WHAT WE CLAIM IS:—

1. A floor covering which comprises a textile surface layer and bonded thereto a non-foamed polyurethane elastomer underlay formed from a polyhydroxy compound and a polyisocyanate used in an OH/NCO molar ratio of from 1:0.6 to 1:1.3.
2. A floor covering as claimed in claim 1 wherein the surface layer comprises two or more superposed layers needled together without additional consolidation.
3. A floor covering as claimed in claim 1 or 2 wherein the surface of the underlay is dry and non-tacky and the OH/NCO molar ratio is from 1:1 to 1:1.3.
4. A floor covering as claimed in claim 1 or 2 wherein the surface of the underlay is self-adhesive and the OH-NCO molar ratio is from 1:0.6 to 1:1.
5. A floor covering as claimed in any of claims 1 to 4 wherein the polyhydroxy compound is a polyether of ethylene glycol, propylene glycol and/or butylene glycol having two or more terminal OH groups and an average molecular weight of from 300 to 5000.
6. A floor covering as claimed in any of claims 1 to 5 wherein the polyisocyanate is tolylene-2,4- or 2,6-diisocyanate or a mixture thereof, a crude phosgenation product of the condensation product of aniline and formaldehyde, diphenylmethane-4,4'-diisocyanate, or diphenylmethane diisocyanate modified with from 5 to 10% by weight of carbodiimide.
7. A floor covering as claimed in any of claims 1 to 6 wherein reaction between the polyhydroxy compound and the polyisocyanate has been accelerated by addition of an activator.

8. A floor covering as claimed in claim 7 wherein the activator is dibutyl tin dilaurate, tin dioctoate or a tertiary amine.

9. A floor covering as claimed in any of claims 1 to 8 wherein the underlay contains a filler.

10. A floor covering as claimed in claim 9 wherein the filler is barium sulphate or kaolin.

11. A floor covering as claimed in claim 1 substantially as hereinabove described.

12. A floor covering as claimed in claim 1 substantially as described with reference to any of the Examples.

13. A process for the production of a floor covering according to claim 1 which comprises mixing the polyhydroxy compound and the polyisocyanate, coating the textile surface layer at room temperature with the resulting liquid mixture which does not foam and storing the product in the absence of tension at least until the polyurethane has solidified.

14. A process for the production of a floor covering according to claim 1 which comprises mixing the polyhydroxy compound and the polyisocyanate, coating a supporting web at room temperature, with the resulting liquid mixture which does not foam, subsequently applying the textile surface layer to the coated web, and storing the product in the absence of tension at least until the polyurethane has solidified and separating the web from the coated textile.

15. A process as claimed in claim 13 or 14 wherein the textile surface layer or the supporting web is coated with the liquid mixture on an endless conveyor belt.

16. A process as claimed in claim 13 or 14 wherein the textile surface layer or the supporting web is coated with the liquid mixture in an apparatus comprising two synchronously driven rollers with a gap between them.

17. A process as claimed in claim 13 substantially as hereinbefore described.

18. A process as claimed in claim 14 substantially as hereinbefore described.

19. Floor coverings when produced by a process as claimed in any of claims 13 to 18.

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